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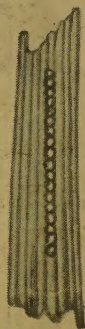
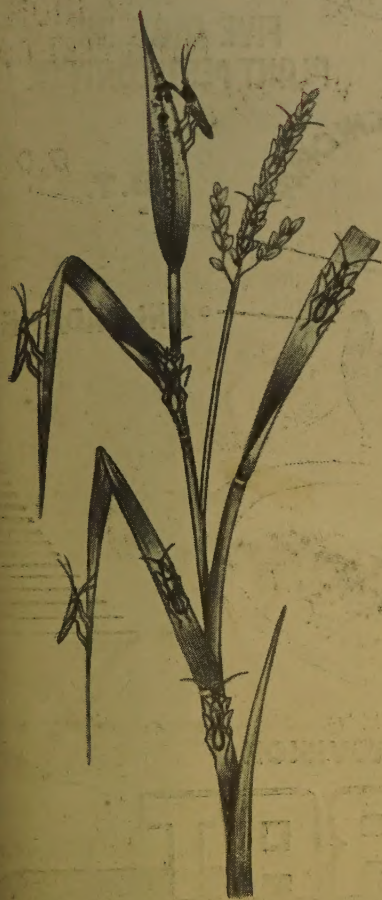
(1953)

DIRECTORATE OF PLANT PROTECTION, QUARANTINE & STORAGE

MINISTRY OF FOOD AND AGRICULTURE, GOVERNMENT OF INDIA

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PRELIMINARY STUDIES ON SYSTEMIC INSECTICIDES

by.

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INTRODUCTION

One of the recent and interesting advancements, in the progress of the insecticidal methods of pest control is the synthesis of chemicals known as "Systemic insecticides". As implied in the name, these preparations, when applied either to the soil or on the plants, are capable of being absorbed and translocated to their different parts along with the cell-sap, rendering the latter highly toxic to a few groups of organisms like aphids, mites, etc., which are essentially sap feeders. Other note-worthy features about these chemicals are that they are retained by the treated plants for sometime and that they have no lethal effects against the parasites and predators which keep the pests in check. These properties not only vouchsafe a temporary immunity to the plants against these pests but also maintain the "balance of nature" so far as the beneficial insects are concerned.

REVIEW OF PREVIOUS WORK

The synthesis of systemic insecticides and their possible adaptability for pest control have been engaging the attention of chemists ever since the first World War. Dimentiev (4 and 5) was the first to try injection of such poisons into plants. He found that a treatment with barium chloride exterminated the woolly aphis—*Eriosma lanigera* Hausman—on apples. Muller (13) has recorded similar results by injecting pyridine and aluminium sulphate. Sanford (17 and 18) and Shattuck (20) have reported the systemic action of potassium cyanide against *Icerya purchasi* Maskell and boring insects on elms. Karrer and Ross (8) have reported that the addition of sodium selenate to the soil, at a concentration of 25 to 50 parts per million controlled the leaf eel-worm and aphids on Chrysanthemum. Martin (11) has pointed out the toxic hazards due to the persistence of this chemical in the soil. Skinner (21) has recorded the efficacy of selenium in controlling psyllids, leaf-miners and mites on box-wood. Neiswander and Morse (14) have proved that the absorption of sodium selenate by the plant tissues upto a concentration of 45 parts per million is highly lethal to aphids and mites. Gnadinger (7) has noted that selenates are poisonous to red spiders. Mason and Phillis (12) have reported that the inclusion of selenium in the nutrition solution for cotton plants grown in sand culture, rendered them free from insects. In spite of the interesting findings, the use of this compound could not make much head-way as it is highly toxic to man and other warm-blooded animals. Another group of chemicals—Organic fluorine compounds—were also noted to possess similar properties. These preparations although comparatively less poisonous were not considered safe enough for practical use (Bennet and Martin) (1 and 3). In the meanwhile, the potentialities of organic phosphorous

compounds with their less toxic and pronounced selective action, came to light. Schrader, (19) after testing over 2,000 preparations, established the high efficacy of Bis (bis dimethyl amino phosphorus) anhydride or Octamethyl pyrophosphoramidate by 1942. Ripper *et al* (17 and 18) exploited this new product against a number of species of aphids, Aleurodids, mealy bugs, jassids and mites. They have also recorded some interesting information on the chemical and physical properties, residual toxicity, etc., of this product. A review of the work done on these new insecticides was published later by Fox Wilson (6). He reports that they are most effective when applied on plants in vigorous growth and that a lapse of at least four weeks is necessary between the last application and harvest to avoid the toxic hazards. Similar studies have been pursued by David *et al* (3) Hartley *et al* (8) and Heath *et al* (9).

WORK DONE

A number of patent preparations like Schraderan, Sytam, Pestox 3 H. and 202, Tetrax and Isopestox [Bis-monoiso-propylamino fluorophosphine] were tested against a variety of pests like aphids, mites, coccids, psyllids, thrips, plant bugs, caterpillars etc. The results were compared with those of some of the insecticides already in vogue, wherever possible and a gist of the findings is furnished below.

I. APHIDAE :

(i) **The lab lab aphid** (*Aphis medicagenis* Koch) : One of the preparations—Schraderan—was tried at the prescribed dosage of 0.075% under the following six conditions in the field and the results compared with those of HETP and tobacco decoction. A gist of the figures is furnished at the end of the paragraph.

- (a) A few severely infested vines were sprayed directly. There was a cent per cent reduction in the population by the end of 48 hours.
- (b) Only the leaf surface was just moistened using the minimum quantity of the spray fluid (about half the usual quantity). A cent per cent mortality of the aphids was recorded by about 48 hours.
- (c) One half of the canopy of the plant was sprayed and the effects on the entire plant were studied. The percentage of reduction in population worked out to 70.4 in the course of 48 hours.
- (d) Only the stem portion of a few infested vines were sprayed upto a height of 2½ and 5 feet from ground level in separate lots and the results noted. The reduction of the pest was slow and steady in both the cases, a complete control being effected in 7 to 10 days.
- (e) The spray fluid was applied to the soil at the base of infested plants at ¼ gallon for each. The reduction in population was 55.3% in the course of 48 hours.

- (i) Aphid-free vines were sprayed to observe the period of immunity conferred on the plants against the pest. Under South Indian conditions the plants did not harbour any of the aphids for four to five weeks.

The data gathered in the above trial are epitomised below.

TREATMENT	Population on six vines over a length of 4" in each case			Percentage of reduction in population in	
	Initial	24 hrs. after	48 hrs. after	24 hrs.	48 hrs.
Entire plants directly treated ..	212	76	..	66	100
treating lightly the upper surface of leaves.	322	94	..	70.8	100
Treating one half of the canopy ..	284	118	84	58.5	70.4
Treating upto 2½ and 5 feet height..	299	264	251	12.0	16.1
Irrigation with spray fluid ..	318	217	142	34.9	55.3
HETP spray 0.1 per cent. ..	248	93	90	62.5	63.7
Tobacco spray	314	132	124	58.0	60.5
Control	262	292	312	..	..

The results show the high efficacy of Schradan at 0.075% and its superiority over HETP and tobacco spray. The added advantage is that the vines are rendered pest free for about four weeks, while those treated with the other two insecticides had a reinfestation in the course of a fortnight. Amongst the different methods, a light spray, just enough to moisten the major portion of the leaf surface, is capable of producing the desired results.

Another but more interesting benefit is the preservation of the predators. Some of the experimental vines had a very severe infestation of the aphid, which had in their turn harboured appreciable numbers of the grubs and adults of the lady bird beetle—*Chilomenes sexmaculata* Fabricius which are predatory on aphids. The intensity of the predator population was not easily evident amidst the host colonies. But with the complete extermination of the latter by the application of the chemical, hundreds of the hungry grubs were seen moving about the vines in search of food. This experience was novel and unique by itself.

Results of a few laboratory experiments have confirmed that Schradan 0.075% has no contact action against the different stages of the lady bird beetle—*Chilomenes sexmaculata* Fabricius and of a species of Syrphid fly—*Syrphus balteatus* de Geer and much less against the host itself.

(ii) The cowpea aphid (*Aphis* sp) : An adequate number of aphid-free cowpea plants were raised in pots. Schradan was applied separately on the plants as well as in the soil at 0.075% and 0.3%, the quantity in each case being one ounce. Fifty specimens of the same species of the aphid

were daily collected from elsewhere and transferred to these plants and their progress watched. A gist of the findings is given below :

- (a) 0.075% *direct spray* : The inoculated specimens did not establish themselves on these plants upto 3-4 weeks as all of them dropped down dead. The toxicity, however, appears to decrease after this period since the subsequent inoculations were successful.
- (b) 0.075% *spray fluid-irrigated* : The toxicity persisted only upto a period of about ten days.
- (c) 0.3% *direct spray* : The introduced aphids failed to thrive upto a period of 4 to 5 weeks.
- (d) 0.3% *spray fluid-irrigated* : The results were similar to those of the direct application of the chemical at this concentration.
- (e) *Control* : The aphids were thriving quite normally in the control lots kept side by side.

The results confirm those of the field studies and also show that the 0.075% dilution is enough to produce the desired results. This spray fluid at the same dosage was also found to exert some phytotoxic action on the lab lab and cowpea plants, but only to a negligible extent. The plants exhibited a slight drooping of the leaves immediately after the treatment but recovered completely the next morning.

II. ACARINA (MITES) :

(i) **The Brinjal mite.** (*Tetranychus telarius* Linnaeus) : The efficacy of the following preparations was tested against this species of mite and the results compared with those of sulphur dust and HETP spray. The trials were conducted on a field scale with four replications. Population counts were recorded in 5 sq. c.m. spaces on five leaves per replication before and 24, 48 hours and a fortnight after the treatments. The data are furnished below.

TREATMENT	Population counts (Average of four replications)			
	Before treatment	24 hours after	48 hours after	Fortnight after
Schradan spray 0.075 per cent.	81	5	..	12
Pestox 3 H. 0.075 per cent.	112	1	..	5
Pestox 202 0.075 per cent.	103	1	..	7
Sytam 0.075 per cent.	77	5	..	9
Isopestox 0.075 per cent.	63	..	..	5
Tetrax 0.075 per cent.	93	5	..	7
HETP spray 0.1 per cent.	77	..	..	8
Sulphur dust	110	..	..	22
Control	67	54	42	34

The above data show that the systemic insecticides compare favourably with sulphur and HETP, not to speak of their residual effects for about a month. Similar exploratory trials against the same mite—*Tetranychus* sp.—on Bhendi (*Hibiscus esculentus*), cucumber (*Cucumis sativus*), tapioca (*Manihot utilissima* Pohl), and castor (*Ricinus communis*) confirmed the above results.

III. COCCIDAE :

(i) Mealy bugs on *Glyricidia* sp. (*Pseudococcus virgatus* Cockerell)
Higher concentrations of Isopestox, Pestox 3 H, Sytam and Tetrax were tried against this pest and the results compared with those of Parathion 0.025%. Population counts were recorded before, 48 hours and a fortnight after the treatment. The data gathered are furnished below :—

TREATMENT	Initial count		Population after 48 hours		Percentage of reduction in population (A. & N) Total	Population after a fortnight		Percentage of reduction with reference to initial population
	A.	N.	A.	N.		A.	N.	
Isopestox 0.15 per cent.	166	234	2	17	95.3	4	1	98.8
Pestox 3 H. 0.15 per cent.	96	1174	16	165	85.8	4	0	99.7
Sytam 3 H. 0.15 per cent.	56	428	33	63	80.0	7	2	98.3
Tetrax 3 H. 0.15 per cent.	131	636	37	106	81.4	12	20	97.0
Parathion 0.025 per cent.	132	281	16	15	92.5	24	77	75.5
Control	4	516	7	653	..	54	603	..

A — Adults

N — Nymphs.

All the systemic chemicals have been quite effective, and compare favourably with Parathion spray.

(ii) The rice mealy bug. (*Ripersia oryzae* Green): Schradan spray 0.075% was first tried against this pest in infested potted plants. The reduction in population was only 14.4% in the course of 72 hours. The effects of higher concentrations at 0.15%, 0.3%, 0.5% and 0.75% were later studied on the infested patches in the field. The mortality figures are as follows :

Concentration of Schradan.

Percentage of mortality in the course of 72 hours.

0.075%

14.4

0.15%

23.9

0.3%

30.9

0.5%

41.7

0.75%

52.2

Though an appreciable mortality has been recorded at 0.75%, these bugs appear to require ten times the dosages prescribed against aphids and mites. The trials will be continued to arrive at the optimum dosage.

(iii) Exploratory trials were conducted with Isopestox 0.075% spray against *Pseudococcus virgatus* Cockerell on cotton, and the reduction worked out to 72% in the course of 48 hours. Similar experiments with Isopestox and Sytam at a higher strength of 0.3% indicated only a negligible mortality of the adults and nymphs upto a week in the case of *Iceya purchasi* Maskell on gorse (*Ulex europaeus*).

IV. MISCELLANEOUS TRIALS :

(i) *Bug pests* : Isopestox 0.075% was sprayed against Tingids on *Barleria* sp. and *Coptosoma cribraria* Fabricius—on lab lab. The entire population was almost exterminated in the course of 48 hours.

Schradan 0.075% was tried against the Jassid—*Empoasca devastans* Distant on bhendi and cotton. The reduction in the former was 39% of the adults and 65% of the nymphs and in the latter 61.8% and 56.7% of the adults and nymphs respectively. The treatment had little or no effect against Aleurodids on gooseberry and *Idiocerus* sp. on mango.

(ii) *Caterpillar pests* : Castor plants grown in pots were sprayed and irrigated separately with equal quantities of Schradan 0.3%. Half-grown caterpillars of *Euproctis* sp. were allowed to feed on the plants *in situ*. All the caterpillars thrived on the leaves for a week, pupated and emerged as adults quite normally.

Similarly castor plants were sprayed with 0.6% Schradan and the leaves were fed to caterpillars of *Prodenia* sp. and *Euproctis* sp. in the laboratory and no untoward effects were noted.

V. SEED TREATMENT :

Cotton seeds were soaked for 6, 12 and 24 hours in Pestox 3 H. diluted to 0.3%. These were planted separately and observed. The germination was normal in all the cases. Specimens of aphids, mites and thrips were collected from the same host elsewhere and introduced on these plants. The results were of no special interest since all these pests were progressing quite normally, on all these plants.

SUMMARY AND CONCLUSIONS :

The investigations have confirmed the results obtained elsewhere regarding this novel method of pest control. The interesting features consist in the mode of action, whereby even light doses confer not only an immediate relief but also an immunity against pest infestation for about four weeks. More than these, the preservation of the parasites and predators is a greater advantage. The present formulations are effective only against aphids, mites, a few species of mealy bugs, tingids, and pentatomid bugs. Further developments would lie in synthesising compounds strong enough to control other important categories of crop pests. The trials being only in the initial stages, no attempts were made to work out the economics of the treatment. In conclusion, a word of caution is necessary

in the use of these chemicals. Though they are reported to be less poisonous than Parathion or HETP, it is advisable to avoid direct contact with the chemical and the application should be stopped, four to six weeks before harvest.

ACKNOWLEDGMENT :

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PRELIMINARY TRIALS OF SOME PROPRIETARY FUNGICIDES AND WEEDICIDES IN THE FIELD

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(Dte. P.P.Q. & S.)

Introduction : The Central Directorate of Plant Protection, Quarantine and Storage, has from time to time been receiving samples of fungicides and weedicides, for field tests against various plant-diseases and weeds under local conditions. The results of field trials with some of these fungicides and weedicides in Delhi State are summarized below and may be useful for plant protection workers elsewhere.

I. FUNGICIDES

1. PERENOX

Composition and Properties : Perenox is a specially prepared cuprous oxide product containing 50% copper, is a reddish-brown, free-flowing, ready-for-use powder which disperses readily on stirring into water. It is generally used in a strength of 0.2 to 0.5% of Perenox or 2 to 5 lbs. in 100 gallons of water.

Diseases against which tried : Perenox was used in a dosage of 0.3 to 0.35% (3 to 3½ lbs. in 100 gallons of water) using 50 to 75 gallons of spray per acre against the following diseases :

Crop	Disease
Brinjal	Leaf-spot (<i>Alternaria solani</i>)
Potato	Early-Blight (<i>Alternaria solani</i>)
Guar (Cluster bean)	Leaf-spot (<i>Alternaria brassicae</i>)
Beet	Leaf-spot (<i>Cercospora beticola</i>)
Citrus	Wither-tip (<i>Colletotrichum gloeosporioides</i>)
Citrus	Canker (<i>Xanthomonas citri</i>)

In the case of citrus the affected branches and leaves were pruned before the spray was applied.

Successful control was obtained in all cases and the diseases were appreciably checked. No toxic effect was noticed on any of the crops.

2. YELLOW CUPROCID

Composition and Properties : Yellow Cuprocid is a reddish-yellow powder, containing 90% yellow cuprous oxide with a metallic copper content of 80%. It is a product of the electrolytic oxidation of copper and can pass a minimum of 99.5% through a 325-mesh screen. It is recommended as a spray material for the control of fungous diseases of foliage, vegetables and fruits. It can also be used in the form of dust for the control of such diseases. As a seed-dressing it is useful in protecting many vegetable seeds against diseases present in the soil.

Diseases against which tried : Yellow cuprocide was used in a dosage of 0.15% (1½ lbs. in 100 gallons of water) against the following diseases :

Crop	Disease
Potato	Early-Blight (<i>Alternaria solani</i>)
Citrus	Wither-tip (<i>Colletotrichum gloeosporioides</i>)
Citrus	Canker (<i>Xanthomonas citri</i>)

Successful control was obtained and further progress of the diseases was checked. There was no toxic effect on the hosts.

Both Perenox and Yellow cuprocide are easy to use and handle and have this advantage over Bordeaux mixture which is rather cumbersome to prepare and necessitates more time and labour.

3. DITHANE Z-78.

Composition and properties : Dithane Z-78 is an organic fungicide containing 65% zinc ethylene bis dithiocarbamate (*Zineb*). It is a light-yellow powder which mixes readily with water to form a suitable spray. Applied to foliage it sticks leaving an almost invisible residue.

Diseases against which tried : Dithane Z-78 was used in a strength of 0.2% (2 lbs. in 100 gallons of water) against the following diseases :

Crop	Disease
Potato	Early-blight (<i>Alternaria solani</i>)
Citrus	Wither-tip (<i>Colletotrichum gloeosporioides</i>)

Effective control of the diseases was obtained and there was no toxic effect on the hosts.

Relative efficacy of the three fungicides could not be determined precisely. However, there were indications that Dithane Z-78 was more effective than Perenox and Yellow Cuprocide against 'Early-blight' (*Alternaria solani*) on potatoes ; whereas the copper fungicides (viz. Perenox and Yellow cuprocide) seemed to be equally effective in the control of 'Early Blight' of potato and the 'Wither-tip' and 'Canker' on citrus.

In the case of 'Wither-tip' and 'Canker' on citrus, the affected parts were thoroughly pruned by the staff of the Directorate where only a few trees were involved. In the case of larger areas, the orchard owners were instructed to do the same, in which case pruning operations were not done in a thorough and satisfactory manner and spraying with the fungicides (Perenox, Yellow Cuprocide etc.) was not quite effective in such cases, as there was a recurrence of the disease after a few months. Hence the previous pruning of affected parts in a proper manner seems to be of paramount importance for the control of these diseases.

II. WEEDICIDES

1. DENOXYLON

Composition and Properties : This chemical is a mixture of Denocate (containing activated dinitro ortho cresol) and Phenoxylylene (containing MCPA). The effects of both Denocate and Phenoxylylene are achieved in a single spraying.

Trials against Cuscuta reflexa (a flowering plant parasite) :

A number of Citrus trees in Sultaipur village were severely infested with this parasite. As an experiment Denoxylon in a strength of 0.25 to 0.5% (1 part in 200 to 400 parts of water) was sprayed on the infested branches during January to February when the parasite was flourishing best. After a week of spraying it was noticed to have partially dried up, more so in the tree sprayed with the heavier dose. There was no marked injury to the Citrus plants. A second spray was given after a week using a 1 : 300 concentration of the weedicide and the parasite was apparently all dried up after 16-20 days. The plants were kept under observation for 2-3 months. Except for a few sporadic cases where the spray could not reach, there was no fresh activity of the parasite subsequently.

2. PHENOXYLENE

Composition and properties : Phenoxylenes are hormone type weed-killers containing MCPA (2-methyl-4-chlorophenoxyacetic acid). It is non-toxic and is safe to apply over a fairly wide range of concentrations.

Weeds against which tried : Phenoxylenes of 0.5 to 1% strength (a part in 100 to 200 parts of water) was tried against the 'Pohli' (*Carthamus oxyacantha*), and 'Jawasa' (*Alhagi camelorum*) weeds infesting wheat and barley crops in the various villages of the Rural Development Scheme in Delhi State.

In the case of the 'Pohli' weed, a 100% kill was obtained in the early stages when the weeds were young and in their vegetative stage. An application of 1 : 200 concentration of the weedicide repeated by a second spray of 1 : 100 after a week was sufficient to kill the weeds completely in 20-30 days. Sprays in the later stages (when the weeds were in the advanced flowering and fruiting stages) were relatively much less effective even in strong doses of 1 : 100.

In the case of 'Jawasa' (*Alhagi camelorum*), a single application of Phenoxylenes (1 : 150) killed the weed both in the vegetative and flowering stages.

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PLANT PROTECTION WORK IN STATE OF AJMER DURING 1951

A. PESTS

I. Locust

Locust swarms, mature as well as immature, visited this State during June, August and December, 1951. Thirty six movements were observed. Direction of flight was as a rule from West to East. Some of the swarms were dusted with 10% BHC. No egg-laying took place in Ajmer State. Hoppers of 3rd to 5th stage were observed in Pushkar circle migrating from Rajasthan. They infested six villages. Control measures against them were carried from 5th September to 4th October. 12,757 infested bushes were dusted with 36 $\frac{3}{4}$ cwt. of BHC. 7,370 infested bushes were burnt with flame guns. One hundred and sixty six infested patches covering an area of about 177 acres were controlled. Ten acres of young cotton and maize were saved from locust damage by scaring away the swarm with smoke. 437 officials of revenue and police, and military personnel were fully trained in anti-locust control measures. Locust film was also shown to the villagers.

II. Grass-hoppers

The out-break of grass-hoppers was about 20% of the last year due to the failure of rains and the systematic dusting operations adopted in the previous year. The pest had spread towards Kekri side which was practically free last year. The most common grass-hopper was *Hieroglyphus nigrorepletus* Bol. The other two grass-hoppers namely *Chloebr* sp. and *Caloptenopsis glaucopsis* Walk. (Catantopinae-Aceridiidae) are also gaining notoriety. Control measures were adopted by dusting the infested bunds with BHC. One hundred and fifty eight centres comprising of 625 villages were fixed for the distribution of insecticide and dusting machines. All the equipment was despatched to the above centres well in advance of the appearance of the pest. Total infested cultivated area was 47,661 acres and practically all of this area was dusted and saved from the ravages of the pest. Out of this area, 31,282 acres comprised of maize, 9,985 and 6,294 acres were of jowar and other non-cereal crops respectively. Approximately 1,35,113 mds. of grain and 1,35,113 cart loads of fodder and 6,294 mds. of other produce, worth about Rs. 35,72,074 were saved. Thirty five and half seers of egg-masses were also dug out from 10 acres and thus the infestation in that area was reduced to negligibility.

III. Field Rats

Damage by the rats to the crops of Kharif as well as of Rabi seasons was widespread. In all, 4,25,733 rat burrows were treated with various rodenticides, e.g. Zinc phosphide, Strichnine hydrochloride, Kuchila seed extract and Cymag. Total area cleared of rat trouble was 2,341 acres in 151 villages. Considering the saving of grains worth about Rs. 5/- per acre total benefit can be roughly stated as Rs. 11,705/-/. The rat trouble was prevalent mostly in Pushkar, Ramsar, Derathu and Gagwana circle of Ajmer Sub-division.

IV. Katra Hairy Caterpillar

Due to less rain-fall, the emergence of moths of the hairy caterpillar (*Amsacta* sp.) was in very small number. Light traps had been set at 16 centres. In all, 1,946 moths were attracted to light. 20 acres of cotton were saved from the damage by hand-picking of the hairy caterpillars from the fields.

V. Vegetable and Fruit Pests

The pests observed were *Euproctis* sp. on papaya, termites on mango seedlings and gulmohar seedlings, Red pumpkin beetles (*Aulacophora* sp.) on cucurbits, Jassids (*Empoasca* sp.) on bhindis, Lace wing bug (*Urentius* sp.) on brinjal, cutworms (*Agrotis* sp.) on cauliflower, mustard saw fly larva (*Athalia* sp.) on cauliflower, etc. 29 acres of vegetables and 800 seedlings of gulmohar were saved from the above pests. Taking Rs. 20/- approximately as saving per acre, total benefit may be estimated at Rs. 580/-.

VI. Storage

(a) Conditions of storage and uses of receptacle for storing grain for seed and food purpose are being studied in the villages.

(b) Fumigation :—7171 mds. of wheat seed during summer and 3,860 mds. of wheat seed and 1,646 mds. of barley seed in winter months stored in Government seed stores were fumigated with carbon tetrachloride and ethylene dichloride mixture (Killoptera) against the stored grain pests.

B. DISEASES

I. Cumin Powdery Mildew

Outbreak of powdery mildew of cumin this year was comparatively much less than previous year. In all 27 acres were dusted in 9 villages with sulphur and the disease prevented from spreading further. The net benefit by this treatment can be roughly estimated to be Rs. 700/-.

II. Seed-borne diseases

In the Kharif season, 1,997 mds. of jowar seed was treated, with Agrosan GN, against the seed-borne diseases. In the 'Rabi' season, 15,887 mds. of barley and wheat seed were similarly treated.

III. Guava virus diseases

Survey was made of all guava gardens in Pushkar area and it was found that out of 15,800 trees, about 3,750 trees were diseased. The orchard growers were advised to cut down the affected trees. As a result, 62 diseased trees were cut.

IV. Citrus virus

Three hundred and fifty citrus trees were sprayed 3 times at intervals of about 5 days with BHC suspension against the white flies.

ABSORPTION AND TRANSLOCATION OF INSECTICIDES BY PLANTS*

As an active substrate, the plant absorbs and translocates the insecticides applied. On these two phenomena would depend the toxicity of chemicals to mammals, plants and insects. Translocated insecticides may cause off-flavour and tainting in edible plants or it may be metabolised into products more toxic than the chemical itself and thus increasing toxic hazard to human beings or animals. Absorption in plants through stomata, lenticels, hydathodes and wound tissue or lipoidal epidermis causes decrease in the amount of insecticide available to insects.

Penetration depends upon nature of the chemical and dynamic processes of plant. Plant cuticle may be highly lipoidal which is conducive to direct penetration of certain chemicals. Once the chemical gets into the plant it is translocated to all cells. Penetration of non-electrolytes depends upon lipid solubility of the insecticide, but compounds with small molecule size can penetrate more easily. The type, age and part of plant, amount of sunlight, moisture and carbondioxide and enzyme activity determine the phenomena of absorption and translocation.

Fumigants :—Gases enter through stomata and general surface. Penetration of HCN, hydrogen sulphide, methyl bromide gases may cause phyto-injury.

Oils :—Oils readily penetrate epidermis and enter through stomata, and thus transport materials dissolved in them. Penetration speed is inversely proportionate to viscosity of the oil. Pure oils penetrate more rapidly than emulsions. Oil itself when penetrated does not cause phyto-injury but insecticide dissolved and impurities present in the oil may injure the plant tissue. It is generally seen that insecticide with oil as a solvent is rapidly lost when applied to plants.

Inorganics :—Arsenics penetrate directly through the epidermis of plants, bark wounds, dormant buds or lenticels in trees. Moisture, wetting agents and weathering make a part of insoluble arsenic soluble which can be checked by adding proper chemicals e.g. ferric oxide or zinc sulphate and lime mixtures. Arsenics are not translocated in plants.

Selenium compounds are absorbed and readily translocated in plant tissues and they may act as systemic insecticides. Sodium selenate acts systemically but its mammalian toxicity is so high that it is not safe to use it.

Natural Botanicals :—Insecticides of vegetable origin are translocated readily within plants. Nicotine, for example, is synthesized in roots and accumulates in other parts of the plant of *Nicotiana* sp. Translocation of pyrethrins in plants is not yet fully known. Derris is insoluble in water but dusted leaves seem to absorb it and translocate to untreated parts. Sodium fluoroacetate (which is found in large quantities in *Dichapetalum cymasum*) is capable of being translocated but its mammalian toxicity is very high.

*Extract from article by J.E. Casida & T. C. Allen in 'Agricultural Chemicals' VII (6), 41-43, 135 and 137.

Synthetic Insecticides :—Can be classed as (i) Chlorinated hydrocarbons and (ii) Organic phosphates.

Chlorinated Hydrocarbons :—DDT is not absorbed or translocated to an appreciable degree. Only rarely plants like citrus or other oily fruit trees containing lipoidal surface may allow DDT to penetrate to the peel and no further. DDT in kerosene may enter plant tissues through foliage and fruit but is again thrown out to the surface where it is applied. In some tropical plants DDT in oil can penetrate to some extent. It is, therefore, assumed that DDT normally does not get into plant substance in amounts to cause any toxic hazard.

BHC, however, is absorbed and translocated in plants in enough quantity and is therefore a source of hazard. BHC is actually incorporated in cell sap.

Toxaphene and chlordane are also absorbed to some extent but the latter causes off-flavour in treated plants. Owing to little solubility in water, toxaphene, chlordane, dieldrin and aldrin are less probable of being translocated in plant. Little is known about the penetration and translocation of these newer insecticides.

Organic Phosphates :—Pure TEPP or HETP is absorbed into plant tissue and inhibits growth and creates disturbances in metabolic processes.

Parathion when applied in soil finds its way into leaves and other aerial parts of the plant and renders the sap toxic to insects. Such insecticides are termed as 'Systemic Insecticides' and they have brought new importance to absorption study. Other systemic insecticides are OMPA (Octamethyl pyrophosphoramidate, 'SYSTOX' (diethyl ethylthiocaptoethyl thiophosphate) and triphosphoric acid penta (dimethylamide). It is not essential that a chemical must have enough water solubility in order to be an effective systemic insecticide as evidenced by 'Systox'.

BRIEF REVIEW OF PLANT PROTECTION WORK IN MYSORE STATE FOR 1951-52

(Division of Entomology, Department of Agriculture)

As a direct result of the intensive and extensive drive against crop pests and diseases carried out for the past three years all over the state, food and other crops in the districts have been fairly free from any major and serious damage and loss on account of insect pests and diseases during the year 51-52 under review. The agriculturists have become more aware of the need to fight out pests and diseases promptly and effectively and their co-operation was received in a fair measure by the Plant Protection Staff.

Among the insect pests of paddy, the Caseworm (*Nymphula depunctalis* Guenee) and the stem borer (*Schoenobius incertellus* Walker) occurred, though on a mild scale almost throughout the year in all the paddy growing areas of the State. Of the two pests, the Caseworm was generally more severe and affected a larger area in different districts, particularly Bangalore and Shimoga districts. On the whole, over 600 acres of paddy was found attacked by this pest and treated for the control of the caseworm in different months. The method of control successfully adopted was the kerosine film treatment. Further demonstrations on this treatment were held by the Plant Protection Staff in the affected areas for the benefit of the cultivators. The paddy stem borer too appeared here and there on small acreages almost throughout the year. The chief methods of control adopted were the prompt uprooting and destruction of affected plants showing 'dead hearts' and also setting up of light traps to trap the adult moths and kill them.

The green beetle (*Leptispa pygmae* Baly) of paddy also appeared in the paddy areas of 'malnad' districts, Hassan (1000 acres) and Shimoga (1068 acres). Demonstrations were held in the kerosine film treatment as for the Caseworm and the cultivators were advised to treat the severely infested plots. The pest, though wide spread, did not assume serious proportions.

Over 2,000 acres of paddy in each of the districts, Mysore and Hassan, were noted to be infested with the paddy gall fly (*Pachydimphosis oryzae* Mani) during the months, September-November 1951. The pest, though seen on vast areas, was not severe and the damage done was low except for small patches here and there. Removal and destruction of the early batch of affected shoots and setting up light traps were quite effective, in checking the pest. The paddy grass hopper (*Hieroglyphus banian* Fabricius) which had been severe particularly in Shimoga district during the previous years, was seen to be doing damage only in small areas in Chitaldrug (7 acres), Mandya (12 acres) and Mysore (50 acres) districts. Control measures were promptly taken up by dusting Benzene hexachloride 7% against the hoppers in the infested areas.

Among the fungal diseases of paddy, the blast disease (*Piricularia oryzae*) was noted in Tumkur, Bangalore, Shimoga and Kolar districts. In all, it was seen over an area of 500 acres from June to December 1951.

and particularly severe over 100 acres in Tumkur district in June. Wherever the crop was affected in the nursery stage, sulphur dusting was adopted.

Another important feature of the plant protection work during the year in relation to pests of paddy crop was the control of field rate which did havoc over an extensive area of 2,700 acres in Mandya district. The entire area was surveyed and prompt control measures were undertaken in cyanogassing the rat burrows found in the infested field bunds.

The Ragi crop was comparatively less subject to insect-attack during the year. The Ragi cutworms (*Lophygma exigua* Hübner and *Euroa segetum* Schiffert-Miller) were noted to cause fairly severe damage over an area of nearly 100 acres in Hassan District during October-November 1951 and on a mild scale in small areas in Chitaldrug and Kolar districts during May-June 1951. Dispersing the poison bait containing either Sodium silicofluoride or Gammexane D.025 in infested fields and nurseries was found useful and the pest was controlled. The Black headed hairy Caterpillar (*Diacrisia obliqua* Walker) was noted over about 14 acres of Ragi in Tumkur and about 50 acres in Kolar districts in August 51. Prompt control measures were undertaken to collect all the congregating young caterpillars and trenching allround the infested fields to trap and kill the caterpillars so that they may not spread further to other neighbouring fields. The Jola ear webbing caterpillar (*Stenachroia elongella* Hampson) was seen in a mild form over an area of about 65 acres of Ragi crop in Mysore district during September-October. It was promptly controlled by dusting the ear with Gammexane D.025 and in seeing that it did not persist in the harvested crop.

A mild infestation of the leaf blight (*Helminthosporium nodulosum*) was noticed on Ragi over an area of about 100 acres in Bangalore district during October. No direct control measure could be undertaken and the cultivators were advised to treat seeds with Agrosan G. N. to minimise chances of disease-attack in the next season.

As usual, a mild outbreak of the ear bug (*Calocoris angustatus* Lethierry) on jola was noticed in the jola areas of Mysore district over an extent of about 1572 acres. The pest was somewhat severe in patches here and there. Demonstrations in dusting Gammexane D.025 over the ear in the infested fields were held throughout the areas to control the pest and the cultivators were persuaded to take up the control measure.

The jola webbing caterpillar (*S. elongella*) in Mysore district and the wingless grasshopper in Chitaldrug district were not serious this year and appeared only in small areas. Prompt control measures consisting of dusting with Gammexane D.025 were undertaken to check the damage done by them.

A small area of 5 acres of jola was found to be infested with the Grain 1 per cent. Copper sulphate solution before sowing was advised to the cultivators.

The cane shoot borer (*Argyria sticticrasis* Hampson) was reported to be serious over about 10 acres of Sugarcane in Kolar district. Suitable advice was given and demonstrations of the 'earthing' of young-cane were conducted.

The Sugarcane Smut (*Ustilago scitaminea*) appeared in a mild form over a few acres of cane in Kolar. The affected plants had to be got removed and destroyed.

There was a fairly severe outbreak of aphid pest (unidentified on groundnut in Chitaldrug district particularly severe in certain parts of Davanagere Taluk; hundreds of acres were affected. Demonstrations in dusting Gammexane D.025 in the affected plots were held through out the area and more particularly in Davanagere Taluk. Mostly Rotary hand dusters were used and they were inadequate for the extensive area to be treated, and as the crop in some cases was in an advanced stage and bushy, these dusters were not quite useful. The necessity for power driven dusters was felt.

Castor crop especially in Tumkur District was noted to be attacked by the semilooper (*Achaea janata* Linnaeus). The pest was found in almost all the castor areas of the district. Demonstrations were held in various castor growing areas on control operations consisting mainly of spraying of calcium arsenate solution in severely infested areas, dusting of Gammexane D.025, and collecting and destroying pupae wherever possible.

A mild infestation of Aphid on Cotton (*Aphis gossypii*) in Chitaldrug and Shimoga districts was noted. Demonstrations in dusting tobacco powder or spraying honey oil soap solution to control the pest were conducted particularly in Chitaldrug district, nearly 100 acres of cotton was seen to be affected. The pest was brought under control.

There was a sporadic outbreak of red headed hairy caterpillar (*Amsacta albistriga*) on cotton in Mysore in a small area of $2\frac{1}{2}$ acres. The pest was noted early to control it by handpicking and so further spread was checked.

Over 250 acres of cotton were noticed to be affected by the Red-Blight disease. Sulphur dusting to minimise damage due to disease was undertaken in certain places. Application of compost to the affected fields was also advised.

As usual hundreds of acres of potato in Kolar, Bangalore and Hassan districts were subject to attack of the Epilachna beetle (*Epilachna vigintioctopunctata* Fabricius). The pest was seen in almost all the months to a greater or lesser extent. The usual method of controlling the pest i.e. spraying with a solution containing calcium arsenate, jaggery and lime was adopted and the pest was brought under control. Demonstrations in spraying were also held in some parts of Hassan.

Sporadic occurrence of aphids on vegetable crops, like cabbage, brinjal etc., were noted in Bangalore, Kolar, Chitaldrug and Hassan Districts. Prompt control measures were undertaken in most cases by spraying with HHongey oil soap solution.

Fairly large acreages of Chillies were found attacked with the leaf curl diseases in Kolar (about 50 acres), Chitaldrug (40 acres) and Bangalore (2½ acres) districts. The disease was fairly severe in Chitaldrug district, when noticed and in other places it was in a mild form. Dusting the affected plots with either sulphur or Benzene hexachloride gave some relief. The Chillies thrips (*Scirtothrips dorsalis* H.) was also noted in about 25 acres of Chillies in a mild form in Kolar district. Dusting with Gammexane D.025 or Hexyelan was adopted to control the pest.

About 1000 plants in Kolar district and about 3.30 acres of Melon in Bangalore district were treated against the aphids by spraying with Honkey oil soap. About an acre of Melon plants were also treated by dusting Gammexane D.025 against the pumpkin beetles (*Aulacophora* sp.) in Hassan District.

Stray cases of an attack by the stem borer (*Chelidonium cinctum* G.) on oranges was noted in Chitaldrug district over an area of 11 acres. Prompt control measures were undertaken by removal and destruction of wilted twigs and injecting 50% phenyl solution into the burrows made by the borer-larvae in the tree trunk wherever found.

The Mango trees in Mandya district and some in Mysore District were sprayed with D.D.T. 550 (Guesarol) against the mango hoppers (*Idiocerus* Spp.), during February—March 1952. It was effective and gave good relief in reducing the hopper-infestation to the minimum.

About 30 acres of Cajanus (‘Thogari’) were found to be affected with Gammexane D.025 (dusting) against the blister disease caused by the capsid bugs, *Helopeltis antonii* Signoret.

About 300 plants of plantain in May, and 500 plants in November 1952, were reported to be attacked by the Pseudo-stem rot disease in Chitaldrug district. All the plants were treated by applying Bordeaux paste to the infected spots, which gave good relief.

Ten palms of Coconut in Chitaldrug district and 17 Areca palms in Tumkur district were treated by incorporating fine sulphur dust into soil around the base of the affected palms to control the ‘Anabe’ disease (*Ganoderma lucidum*).

About 30 acres of Cajanus (‘Thogari’) were found to be affected with the disease (*Fusarium vasinfectum*) in stray patches in Bangalore district. The affected plants had to be got removed and burnt to prevent the disease from spreading.

Two acres of wheat in Tumkur district were found infected by the brown rust (*Puccinia tritricina*) during January '52 and the infected plot was treated by dusting sulphur immediately, which gave the required relief.

CHEMICAL CONTROL OF GRASSHOPPERS*

During the past six years, experiments have been carried on at the Oklahoma Agricultural Experiment Station in U.S.A. to determine the value of different chemical compositions as grasshopper-poisons. Laboratory tests were made to establish a basis for the rate of application in field experiments and to measure comparative stomach and contact toxicity. Residual effectiveness was measured by field|laboratory methods. The grasshopper species used were *Melanoplus differentialis*, *M. mexicanus* and *M. vittatus*.

General Comparisons

Dieldrin was consistently the most insecticidally active material tested, both as a stomach and contact poison. It also had a longer residual period and killed very rapidly. There was significant evidence that grasshoppers were being poisoned by plants upon which the insecticide was three weeks old. Because of this three-way effectiveness, dieldrin can be applied at very low rates yet give excellent kill. Evidence continues to accumulate showing that dieldrin at these low-rates would be as safe to man and warm blooded animals as many other insecticides.

Parathion was very toxic to the grasshoppers. It killed rapidly and acted both as a stomach and contact poison although it was somewhat better as a stomach poison. Parathion had a residual period as a grasshopper toxin of only one or two days. This was the shortest time for any of the chemicals tested. It can be used for good economical control at very low rates of application. Its hazard to the operator during application is its chief disadvantage although if handled carefully, it can be used safely. Best control was obtained when temperatures were above 80 degrees F. Sprays were a little better than dusts.

Aldrin was a very good toxicant. It was most effective as a stomach poison and sprays were better than dusts. This chemical is being widely used for excellent and economical control with low rates of application. Sprayed plants had lost their toxicity to grasshoppers by the end of two and one half weeks.

Heptachlor was comparable to aldrin as a stomach and contact toxin. No data were obtained concerning its residual characteristics, but presumably these would be fairly good. Heptachlor is another excellent grasshopper poison.

EPN 300 was the fastest acting stomach poison tested and was very toxic. Poor results were obtained when it was used as a contact poison at a concentration of 0.25. Results from tests where very low concentrations were used, suggested the chemical was gone before grasshopper feeding on plants obtained a lethal dose. This indicated a short residual period probably comparable to parathion. EPN 300 would need to be used at a higher rate than parathion in order to give comparable results in the field. Erratic results probably would occur unless it was applied at rates higher than 0.25 pound per acre, since it would depend considerably on grasshopper feeding.

*Extract from an article by Charles H. Brett in "Agricultural Chemicals" Vol. 7, No. 5, May 1952, pp. 50-52 and 135-136.

Compound 1189 was not fast acting ; however, it gave very good results as a stomach poison. It was poor as a contact poison, killing no grasshoppers until rather high concentrations were used. Since it would depend almost entirely on grasshopper feeding it would be expected to give erratic results in the field.

Gamma BHC was most effective as a contact poison. It had a short residual period but gave good results in field tests. Dusts were better than sprays and best results were obtained when temperatures were about 80 degrees F.

Chlordane is almost an old timer in grasshopper control. It is comparable to aldrin when used at higher rates. Competition between these materials remains largely a matter of price. Chlordane sprays were superior to dusts. Residual effectiveness of chlordane was a little less than that of aldrin.

Toxaphene has done well in grasshopper control when used at a high rate of application. This has been possible because of its low cost. It had a short residual period and was slow acting. Toxaphene sprays were better than dusts.

Dilan was not tested extensively. It was evident that rather high concentrations would be necessary to obtain good results and this does not appear to be economical at present.

Time of application for any grasshopper toxin is of great importance. The economic species lay their eggs in the soil of fence rows, roadsides, creek beds, ditch banks, pastures and the margins of fields. In Oklahoma, the nymphs usually hatch from the middle of April to the middle of May, but this is considerably affected by the season. Warm seasons cause early hatching and cold, wet seasons result in late hatching. The period at about the end of hatching is the most favourable time for the application of insecticides. Effectiveness of control is gradually lost as the grasshoppers grow and distribute themselves over wider areas. By the last of June, some of them will be reaching the adult stage. These have wings and may fly great distances, complicating control considerably, since many acres may become infested and adults are not so easily killed as nymphs.

MODEL PHYTOSANITARY CERTIFICATE.

According to the International Plant Protection Convention to which India has become a signatory, each contracting Government undertakes not to require consignments of plants intended for planting or propagation, imported into its territories, to be accompanied by phytosanitary certificates inconsistent with the model set out below :—

MODEL PHYTOSANITARY CERTIFICATE

PLANT PROTECTION SERVICE

OF.....

NO.....

This is to certify

that the plants, parts of plants or plant products described below or representative samples of them were thoroughly examined on (date)..... by (name)..... an authorized officer of the (service)..... and were found to the best of his knowledge to be substantially free from injurious diseases and pests ; and that the consignment is believed to conform with the current phytosanitary regulations of the importing country both as stated in the additional declaration hereon and otherwise.

Fumigation or disinfection treatment (if required by importing country) :

Date..... Treatment.....

Duration of exposure..... Chemical and concentration.....

Additional declaration

.....19.....

.....
(RANK)

.....
(SIGNATURE)

(Stamp of the Service)

DESCRIPTION OF THE CONSIGNMENT

Name and address of exporter.....

Name and address of consignee.....

Number and description of packages.....

Distinguishing marks.....

Origin (if required by importing country).....

Means of conveyance.....

Point of entry.....

Quantity and name of produce.....

Botanical name (if required by importing country).....

NOTES AND NEWS

Control of cumin mildew in Bombay State*

Seven thousand acres of cumin were dusted with sulphur against mildew in the Molsana and Kaira districts of the Bombay State during January to February, 1952.

A New Weed-Killer†

A new chemical weed-killer against mixed grasses and broad leaf weeds, by name 'CMU' has been developed by E.I. du Pont de Nemours & Co. The chemical ingredient in it is 3-(p-chlorophenyl)-1,1-dimethylurea. It has been tested on Bermuda grass, quack grass, and bind-weeds, throughout America and it has given very good results.

The chemical when applied on the fields, is absorbed by the roots and is later translocated to the foliage. After some time the tips of the leaves begin to dry up and then the whole leaf and ultimately the whole plant dies. Discolouration of the leaf is also seen, prior to the death of the plants. This chemical can mostly be used to check the growth of grasses on railway tracts, oil storage tanks and electric poles, etc. The one outstanding feature of this chemical is that it is not inflammable and will not eat away the surface on which it is applied.

Record of virus disease of papaya in Assam‡

In papaya, a virus disease was noticed. The symptoms of the disease were mottling of the leaves and exudation of latex from the fruit. The trouble was found very serious and a very high percentage of the plants and fruit was affected.

Aerial Spraying assists Production in Australia§

Six Tiger Moth and twelve other aircrafts of the Company (Air Grievance Control Ltd.) are busy in controlling heliothis caterpillar and other insects in Australia. Linseed crop, potato, tobacco, cotton, barley and oats are being successfully controlled against caterpillar, leaf miner, cut-worms, stem borers and boll weevil. In addition to this, weeds are also being controlled, the total cost of this to the land holder is 31s. 6d. (Australian) an acre. Weeds should be controlled before harvesting. A crop of linseed infested with crown borer and prickly lettuce rendering harvesting impossible, was sprayed with 2, 4-D ester, and weeds were knocked back. Similarly variegated thistle, wild turnip weed and prickly lettuce were controlled in early growth.

Insecticides stimulate Tree Growth||

Yet another unsolved mystery of agricultural chemistry has turned up, this time related to the stimulation of plant-growth. U.S. Department

*Abstract from the quarterly report of the State of Bombay for the period ending February, 1952.

†Extract from 'American Agriculture', 51-A-26; p. 10, December, 1951.

‡Extract from the report on the occurrence of the plant diseases in Assam during the month of April, 1952, by S. Chowdhury, Mycologist, Assam.

§Extract from Agricultural News letter. Release No. AGN/352.

|| Extract from Science News Letter No. 81 issued by Scientific Adviser Indian High Commission, London.

of Agriculture scientists have confirmed that ten chemicals (lead arsenate, parathion, DDT, BHC, chlordane, toxaphene, zinc-lime, sulphur, fermate and 2, 4-D), applied to the soil in higher concentrations than are employed for spraying foliage, stimulate the growth of young fruit trees. Peach trees made four times as much growth when the soil-surface was treated with 10 times the normal concentration of benzene hexachloride. Preliminary results tend to show that the effect is not explained by the destruction of soil pests; suppression of the covering vegetation may be a factor. Adoption of soil treatment with high concentration of insecticides and weed-killers is not recommended to fruit growers at this stage; several years of experiment will be necessary to check the results and investigate effects on fruit quality. (Chemical & Engineering News 74.52 p. 1406, 1408).

Importance of Particle Size in Spraying*

The size of the particles that come out of the nozzle of the spraying equipment has great effect on the spread of insecticide on the sprayed surface. Delivered in drops 50 microns† in diameter, a gallon of spray to the acre will provide 9 drops to the square inch. If the gallon of spray went out in particles one 5 micron in diameter, it would provide more than 9 million particles to each square inch of an acre of ground.

In still air, the scientists find, a 5-micron drop of water will fall 10 ft. in 66 minutes; a 100-micron drop will settle at the rate of 10 ft. in about 10 seconds and the 500-micron drop in a little more than a second and a half. In a slight breeze of only 3 miles an hour, a 5-micron drop will drift more than 3 miles in dropping 10 ft.; a drop of 33 microns diameter would drift 409 ft. and a 500 micron drop would settle 10 ft. with a drift of only about 7 ft. These figures indicate the importance of controlling droplet size and considering wind drift in applying insecticides. The new insecticides with their high power for killing insects when applied in an effective way, make precise regulation of spraying equipment extremely important.

Systox, a new systemic Insecticide‡

Called 'Systox', the product recently was given federal approval in U.S.A. for control of aphid and two spotted spider mite on cotton. It will be used only as a spray for the present. It has the following advantages over the conventional insecticides:

1. It could render treated plants toxic to insects three to four times longer.
2. Rain could not wash off or dilute the chemical because it would be absorbed into the plant.
3. It could be applied to seeds before planting, giving protection to the young plants for a considerable time.
4. It would be effective in small doses.
5. It would not have to be sprayed on insects to be effective.

*Extract from 'American Fruit Grower', March, 1950, p. 27.

†A micron is one millionth of a meter.

‡Extract from 'Farm Chemicals', 115(6), pp. 13-14, 1952.

Technically, it is an organic phosphate ester of the empirical formula $C_8H_{19}O_3S_2P$. It spreads throughout a treated plant by translocation. The chemical is marketed by Pittsburgh Agricultural Chemicals as a concentrated liquid which is added in minute proportions to water. It is compatible with DDT, dieldrin, BHC, chlordane, toxaphene, quinenes, aldrin, rotenone, pyrethrum and various oils; doubtful with zinc arsenate, calcium arsenate, Paris green, cryolite and organic mercury compounds, incompatible with Bordeaux, lime and lime sulphur.

Toxicity.—Residues reduce to a minimum quickly. These are considerably lower than DDT's level of 4 to 5 ppm, 12 to 15 days after application and arsenate of lead's 5 to 7 ppm, after 15 to 20 days according to the manufacturer.

Length of effectiveness.—Kills insects for longer period than regular insecticides. Field tests have shown that only two applications a season are required for control in most cases.

Cost.—One application for cotton per acre would be \$1.50 to \$2.

Application.—Systox forms an emulsion in water and can be diluted to any strength. It is suitable for use in all power operated ground sprayers and aircraft sprayers.

Protective clothing including natural rubber gloves, are recommended for the operator.

A bacterial disease of tomato new to India*

Recently an important disease of tomato, the 'Bacterial Canker' or the 'Grand Rapids' disease (*Corynebacterium michiganense* (Smith) Jensen) was for the first time reported from Madhya Pradesh. It is characterized by progressive wilting of the foliage and the development of streaks or cankers on the stems, petioles and peduncles. The disease is transmitted through seed. Every care should be taken to prevent its spread by obtaining seed from disease-free plants or even localities. As a further safeguard, seed may also be disinfected by immersion in a weak suspension of an organic mercury fungicide (e.g. N.I.C., 5 minutes treatment in a 1:1200 suspension).

Russian Knapweed (*Centaurea repens*)†

This weed, sometimes called the creeping knapweed, is a native of Turkestan in southern Russia. It has now spread to several countries and has become a serious weed pest. In Canada, the weed is reported to grow very rapidly, one root having produced a patch with a diameter of 61 feet in two years. Because of its extensive system of underground runners, the plant retards growth of crops and if infestation is thick, practically suppresses them altogether. Its eradication is difficult. Cultivation appears to encourage its growth. It has also the disadvantage that the pieces of the roots break off and are carried on implements to clean areas. Sodium

* Abstract from Science and Culture 17(1) : 46, 1951.

† Extract from Advisory Leaflet No. 222, Division of Plant Industry, Department of Agriculture and Stock, Queensland.

chlorate kills the tops but regrowth is often considerable. Preliminary experiments indicate that it may be possible to control the weed by cultivating in the spring, then spraying the rosettes with 2, 4-D or 2, 4-D|2, 4, 5-T mixtures at the rate of 2 lbs. active ingredients per acre. On account of its very destructive nature, it has been recently declared a noxious plant in Queensland, Australia.

Malathion, a new insecticide*

This is a new organic phosphate containing the chemical 0.0-dimethyl dithiophosphate of diethyl mercaptosuccinate. This compound was formerly designated as S-(1, 2-dicarbothoxyethyl) 0.0-dimethyl dithiophosphate and also as experimental insecticide No. 4049. Its empirical formula is $C_{10}H_{19}O_6PS_2$. It is a high boiling deep brown to yellow liquid. The purity of technical grade is 85 to 95 per cent. It is slightly soluble in water (143 ppm.) but is miscible with many organic solvents including alcohols, esters, ketones, ethers, aromatic and alkylated aromatic hydrocarbons and vegetable oils. It has a very limited solubility in certain paraffinic hydrocarbons without the use of a mutual solvent. Malathion decomposes most rapidly under conditions where the pH is about 7.0 or below 5.0. No hydrolysis was obtained for 336 hours in an aqueous solution buffered to initial pH of 5.26. At a pH of 7.5, hydrolysis was 11 per cent in 22 hours. When alkaline insecticides and fungicides are added to the spray tank with formulations containing malathion, the initial kills are satisfactory but the residual toxicity is decreased. Preliminary information indicates that both the wettable powder and the emulsion may be used with the more commonly used insecticides. In tests made in 1950 and 1951, formulations containing malathion were used satisfactorily with DDT, lead arsenate, methoxychlor, mineral oil, parathion, TDE, ferbam, tribasis copper sulphate, wettable sulphur, zinob and ziram. Neither phytotoxic effects nor decrease in insecticidal efficiency were reported with these combinations. This insecticide seems to be tolerated by most plants at the contrations used for insect control. This insecticide has been found to be very effective against European red mite, two-spotted spider mite, Willamette mite, Pacific mite. Clover mite, Schoenii mite, Woolly apple aphid, Fruit tree leaf roller, Black cherry aphid, Pear psylla, Mealy plum aphid, Mexican bean beetle, Imported cabbage worm, Green peach aphid, Pea aphid, Pea weevil, Potato aphid, Turnip aphid, Hop aphid and Green peach aphid. It has also shown considerable promise against Forbes scale, Red banded leaf roller, Green apple aphid, Codling moth, Bud moth, California red scale, Florida red scale, Yellow scale, Purple scale, Black scale, Citricola scale, Soft (brown) scale, Grape mealybug, Grape berry moth, Peach tree borer, Mealybug, Cabbage aphid, Serpentine leaf miner, Spider mites, aphids, scale insects and whiteflies, but has not given satisfactory control at reasonable dosages against Cabbage maggot, Cherry maggot, Corn earwormy Cucumber beetle, European corn borer. European sawfly, Flea beetle, Lygus bug, Onion maggot, Onion thrip, Oriental fruit moth, Plum curculio, Spittlebug, Tobacco budworm, and Tobacco hornworm.

*Compiled by the Directorate of Plant Protection, Quarantine and Storage, from various sources.

